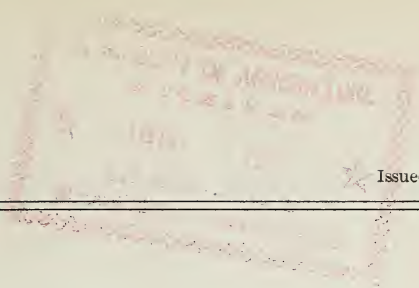


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B. T. GALLOWAY, Chief of Bureau.

WART DISEASE OF THE POTATO;

A DANGEROUS EUROPEAN DISEASE LIABLE TO BE
INTRODUCED INTO THE UNITED STATES.

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WART DISEASE OF THE POTATO;

A DANGEROUS EUROPEAN DISEASE LIABLE TO BE INTRODUCED INTO THE UNITED STATES.

INTRODUCTION.

A new disease of the potato which has been exciting alarm in Europe is likely to be introduced into this country at any time. This circular is issued to call the attention of American growers and importers of potatoes to this danger and to urge their cooperation in an effort to prevent it from securing a foothold here. It is important that any cases discovered be promptly reported and all possible means taken to prevent its occurrence.

DESCRIPTION OF THE DISEASE.

The disease, which has been known as “warty disease,” “black scab,” “canker,” and “cauliflower,” is one which attacks the tuber principally, and consequently is not observed until harvesting time. In a bad attack of the disease big, dark, warty excrescences, sometimes as large as the tuber itself, appear on its sides or ends. “The growth consists here of a mass of coral-like or more or less scabby excrescences or nodules, similar in appearance to the well-known crown or root gall of apples. The adherent earth can be easily washed off when the character of the growth becomes more apparent. It is not spongy and not detachable from the tuber. It is of a somewhat lighter color at the base and dotted with minute rusty-brown spots over the surface. * * * In an advanced stage the tubers are wholly covered by this growth, having lost every resemblance to potatoes. They are lumps of irregular outline, never spherical or oblong, but simply a mass of ragged and edged excrescences. * * * A still more advanced stage occurs when the fungus has utilized every particle of food stored in the tuber and has reduced it to a brownish-black soft mass giving off a very unpleasant putrefactive odor. This is the most dangerous stage of the disease, and the tubers which have reached it can not be harvested whole. They break in pieces, and thus the brownish, pulpy mass, consisting almost entirely of spores of the fungus

and remains of the cell walls of the potato, is broken up, the spores are liberated in millions, and the land is badly infected for years." (Güssow, 1909.) (See Pls. I and II.)

In a mild attack the eyes first appear grayish, then turn brown, and finally black, while in a healthy tuber these are whitish or purplish in color. The tuber is only slightly disfigured and its keeping qualities do not seem to be impaired.

While the tuber is the part of the plant chiefly affected, infection may take place in all the young tissues of the plant, the roots, stolons, stems, and even the leaves.

THREATENING NATURE OF THE DISEASE.

All reports indicate that the potato wart is one of the most serious of all known diseases of the potato. It converts the tuber into an ugly, irregular, and utterly unsalable growth. When established in a field it may affect the entire crop, and the land remains so infected that potatoes can not be successfully grown for six or more years.

We quote from writers abroad the following:

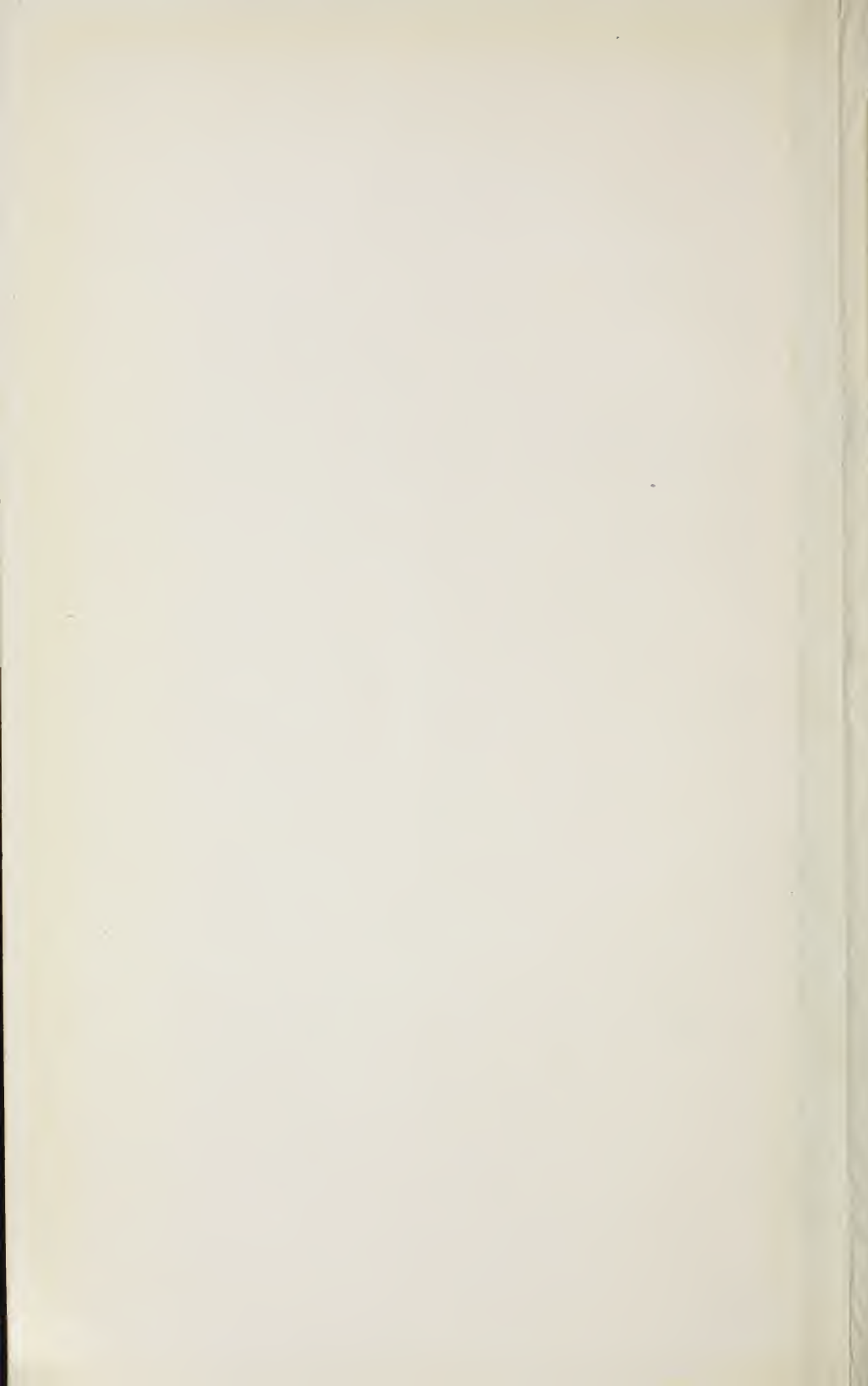
J. W. Eastham (Yearbook, College of Agriculture and Horticulture, Holmes Chapel, 1904): "When once established in the land it is useless to grow potatoes again until the pest has been starved out or otherwise destroyed; but so far as is known no other crops are liable to be attacked. Quite the worst case seen in Cheshire occurred on land that had not borne potatoes for six years; 'seed' from the same source as that employed on this land yielded satisfactory results elsewhere, indicating that spores were not introduced by the seed, whilst the manure employed started no infection elsewhere. This indicates prolonged vitality on the part of the fungus, which would render starving out a very tedious process."

E. S. Salmon (Gardeners' Chronicle, 1907): "It is quite clear, however, that the 'black scab' disease threatens to inflict such serious injury on the potato crop as to warrant the Board of Agriculture taking official action. * * * The disease is viewed with alarm by both the scientific and the practical man, and yet no steps are being taken to deal with this pest which, if it is allowed to spread through the country and to reach Ireland, will cause losses of hundreds of thousands of pounds."

Borthwick (1907), referring to an outbreak in Scotland, says: "The whole crop was damaged to the extent that they could not be used. They were quite useless, the early varieties being, if anything, worse than the late, especially the early kidneys. The disease was first noticed when the new potatoes began to form. It first appeared on the stems as a greenish-looking canker, which attacked the tubers as they grew and soon made them a mass of corruption."



POTATO PLANT ATTACKED BY WART DISEASE. (AFTER GÜSSOW.)



M. C. Potter (Gardening, 1908): "From all accounts the disease is spreading rapidly in the infested areas and the amount of damage is yearly increasing. * * * In certain allotments * * * it has been found impossible to grow potatoes."

John Percival (1909): "Potato wart has already become a serious trouble in many districts in this country, and it is likely to develop into the worst pest with which the grower will have to deal unless vigorous measures are adopted to stamp it out."

T. Johnson (1909): "It needs only a very casual acquaintance with the facts of the case in the British Isles from the time of the discovery of the trouble by Potter in 1902 to the present time to warn one of the necessity of taking all possible steps to stamp out a disease which may become as serious as ordinary leaf-blight and less amenable to treatment. * * * It is now found in many districts in England, Wales, and Scotland. It is often so pronounced as to destroy the whole crop, and it is not confined to garden plots. Warty tubers are naturally poorer in food matter than healthy ones, and when not destroyed in the field do not keep well in store. They ought to be destroyed as soon as found, and on no account saved for seed."

The Gardeners' Chronicle, 1908: "This disease * * * is exciting some alarm in Germany, where it is said to be spreading. It appears to have been recognized as of local occurrence for some time in the neighborhood of Düsseldorf, Elberfeld. * * * During this season it has proved so injurious as to have entirely destroyed the crop in many gardens where potatoes have been raised year by year."

Dr. O. Appel (1908), on the other hand, says: "According to reports of Spieckermann, Schneider, and Jösting, who have observed it this year in Germany, the disease is not of economic importance."

The British Board of Agriculture and Fisheries made it a notifiable disease in 1907 under the Destructive Insects and Pests Acts, 1877-1907. The following report (Gardeners' Chronicle, 1909) was made: "The board of agriculture and fisheries desire to notify that 244 cases of wart disease or black scab in this year's potato crop had been reported to them up to October 3. These cases have occurred in the following counties: Shropshire, 60; Staffordshire, 57; Lancashire, 50; Cheshire, 30; Warwickshire, 25; Worcestershire and Leicestershire, 4 each; Derbyshire, 3; Merioneth, 2; and 1 each in Perthshire, Stirlingshire, Dumfriesshire, Cumberland, Nottingham, Berkshire, Flintshire, Breckshire, and Glamorgan. A few cases among field crops have been found in the counties in which the disease is most common, but in the great majority of cases the disease has occurred on allotments or in gardens in which potatoes are constantly grown * * *. The disease has been known in certain districts for ten to fifteen years, and as growers have taken no steps to check its progress, it is now causing

serious loss * * *. All cases of wart disease must be notified to the secretary, board of agriculture and fisheries * * *. In the case of farmers who sell 'seed' potatoes, notification of the disease is of especial importance, and failure to notify must be regarded as a serious offense * * *. Persons concealing wart disease are liable to prosecution and a penalty of £10."

PRESENT DISTRIBUTION OF THE DISEASE.

The disease has been reported from England (see p. 5), from Scotland in Perth, Sterling, and Clackmannan counties; from Ireland in Down County; from Wales; from Germany in Westphalia and the Rhine provinces; and from upper Hungary. It has not yet been brought to the United States so far as known, but has already crossed the Atlantic and become prevalent in Newfoundland, where it was lately discovered by Dr. H. T. Güssow, Dominion botanist, who presented a very interesting paper on the subject in December, 1909, before the American Phytopathological Society. Knowing the serious character of the new pest from personal observation of the losses caused in England, he promptly issued a warning bulletin. The Canadian government proposes taking active measures to prevent the further introduction of the disease. Doctor Güssow stated that there have been recent importations of seed potatoes from Newfoundland into the United States.

NATURE OF THE PARASITE.

The organism causing the disease is a fungus discovered in 1896 in potatoes from upper Hungary by Schilbersky, who named it *Chrysophlyctis endobiotica* and placed it in the lowest group of the Chytridiaceæ, Olpidiaceæ. By others the fungus has been supposed to be *Oedomyces leproides*. We quote from the excellent description of Prof. T. Johnson, as follows: "The vegetative form consists of a naked mass of protoplasm which may be distinguished in the host cells (just below the epidermis) by being denser, homogeneous, and finely granular. It may be seen abutting on the host protoplasm, and disputing with it, as it devours it, occupation of the enlarging cell cavity. The protoplasm follows and then the cell wall. This, though brown, does not, like the protoplasm and nucleus, disappear. The starch grains are the last attacked and remain white and uninjured for some time in an invaded cell. The parasitic plasmodium passes from cell to cell by boring its passage through the host cell wall * * *. It is in this stage that it stimulates to active cell division the surrounding host cells and produces the gall or wart."



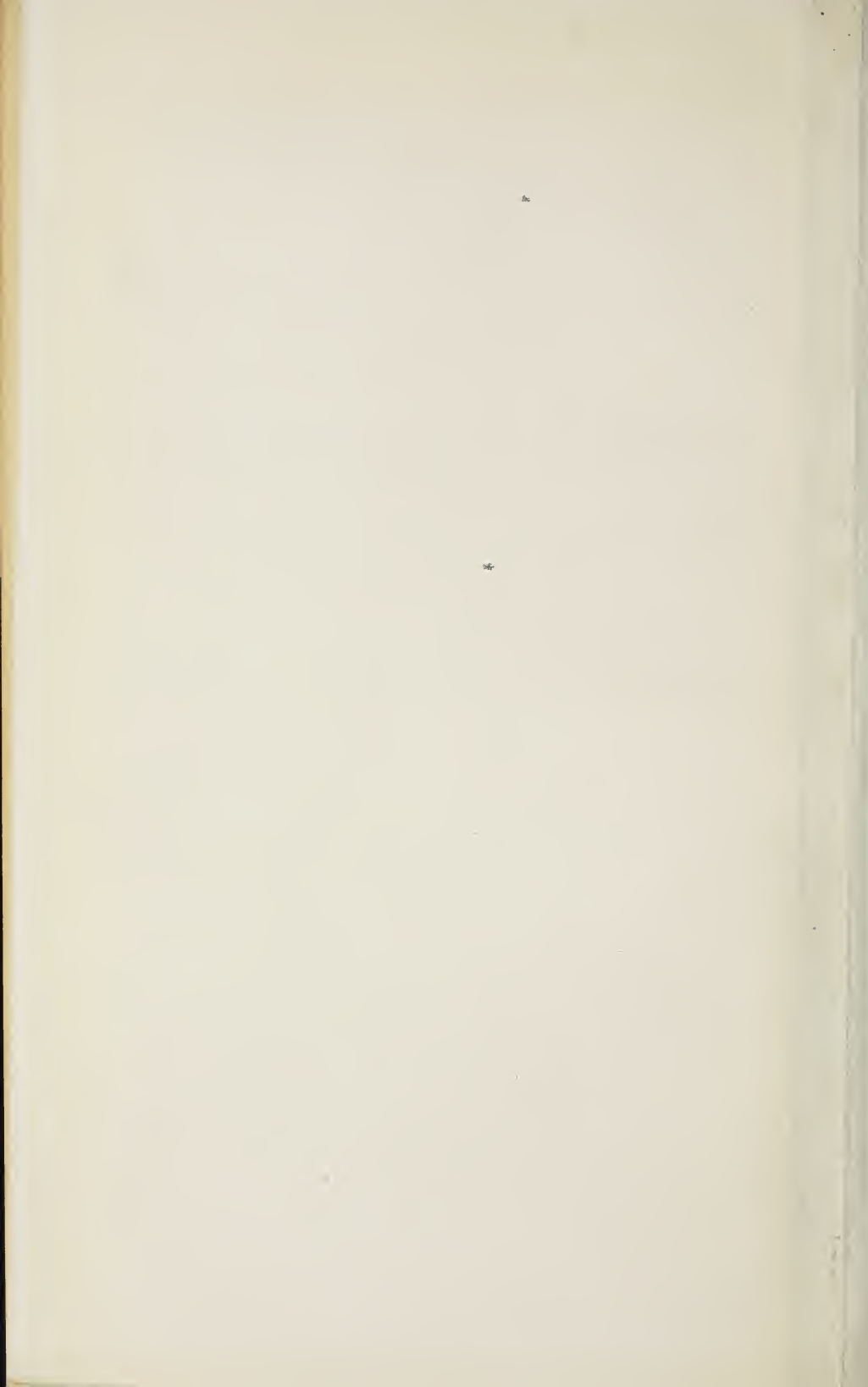
RESTING SPORES OF WART DISEASE.

Section through a small tubercle showing sporangia. (After Güssow.)



TUBER SHOWING WARTY EXCRESCENCES.

(From Journal of Board of Agriculture, January, 1909.)



During the summer the plasmodium rounds up, forming a smooth, yellowish wall about itself. Later the contents of these zoosporangia break up into numerous zoospores, which escape through a hole in the wall and attack healthy potato tissue.

"As the tuber ripens the parasite replaces the summer sporangia by resting ones, which carry the disease through the winter and serve to propagate it in the spring * * *. The resting sporangia, 30-70 μ in diameter, are very numerous in diseased tubers and are easily recognizable with a pocket lens. Under the microscope the wall is seen to be not smooth, but ridged or angular. These brown ridges or bands form part of a kind of episporium which arises as the sporangium ripens, and seems to be formed from the residual contents of the host cell when not also from its cell wall as well * * *. The episporium is thus deposited from without as a third layer on the thickening wall of the sporangium. If this more or less artificial episporium is ignored, then one may speak of the spore wall as smooth * * *. As a rule there is only one resting sporangium in a host cell; occasionally there are two." It is exceedingly difficult to germinate these resting spores artificially. Professor Johnson succeeded in bringing about germination by placing them in potato juice. He writes: "At last the potato juice, exercising possibly a chemotactic influence, gave success; and sporangia with split walls and escaping zoospores were found. These showed the same sluggish movements observed in the sporangia of certain other Chytridians disturbed during their resting period. Each sporangium contains hundreds of more or less pear-shaped uniciliate zoospores. The zoospores measure from 1.5 to 2.4 μ in diameter. The body is actively amoeboid, while the cilium is comparatively passive." (T. Johnson, 1909.)

Infection takes place usually at the "eyes" of the tuber through the zoospores of either the summer or resting sporangia which are found infesting the surrounding soil. It is also believed by Johnson and others that infection may take place through the internal passage of plasmodia from diseased seed passing through the stolons arising therefrom, and so into the newly-formed tubers.

MEANS OF EXCLUSION.

At the present time the United States has no legislation that will prevent the importation of such a trouble. No quarantine is maintained against plant diseases, nor is the Secretary of Agriculture authorized to inspect or reject infected potatoes, seeds, or nursery stock of any description.

The most effective protection against the importation of potatoes is the tariff of 25 cents a bushel. Yet in spite of this the following quantities have come to our markets from abroad:^a

Country from which imported.	Year ended June 30—					
	1906.		1907.		1908.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	<i>Bushels.</i>	<i>Dollars.</i>	<i>Bushels.</i>	<i>Dollars.</i>	<i>Bushels.</i>	<i>Dollars.</i>
Austria-Hungary	34,909	17,146	741	331	1,723	746
Belgium	37,275	14,422	75	84	6,889	3,650
Bermuda	68,964	95,205	87,048	135,569	80,711	109,561
Canada	421,106	126,798	11,393	5,970	177,102	80,006
Germany	152,323	69,761	39,419	19,984	62,059	38,368
Netherlands	9,316	5,379	5,704	2,184	38,892	18,169
Spain	1,774	1,558	7,730	7,408	11,246	11,596
United Kingdom	1,192,074	504,377	5,673	3,706	2,269	1,321
Other countries	30,419	18,417	19,134	17,399	23,061	19,615
Total	1,948,160	853,063	176,917	192,635	403,952	283,032

The principal ports of entry of potatoes in 1908 were as follows: Aroostook, Me., 67,766 bushels; Bangor, Me., 56,312 bushels; Boston and Charlestown, Mass., 34,901 bushels; New York, 202,069 bushels; Passamaquoddy, Me., 3,286 bushels; Porto Rico, 19,285 bushels; Key West, Fla., 2,643 bushels; Arizona, 8,243 bushels; Champlain, N. Y., 1,390 bushels; other ports, 8,057 bushels. Total, 403,952 bushels.^b

Since the interest and knowledge of the public must be our main dependence in preventing the establishment of the potato wart in America, it is urged that all importers, dealers, and consumers of foreign potatoes watch for the disease and promptly report to the Department of Agriculture at Washington any cases discovered.

All infected potatoes should be boiled or burned. No part of any lot containing diseased potatoes should be used for seed purposes.

If the disease is found on growing potatoes, heroic measures should be taken to eradicate the trouble by burning the entire lot and planting no more potatoes on that field for six or seven years.

There should be some modification of our laws so as to enable the Secretary of Agriculture to deal promptly with special dangers of this sort arising from the importation of infected plants.

^a Bulletin 76, Bureau of Statistics, U. S. Dept. of Agriculture, p. 54.

^b Information furnished by Bureau of Statistics, U. S. Dept. of Agriculture.

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Approved:

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WASHINGTON, D. C., *February 4, 1910.*

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